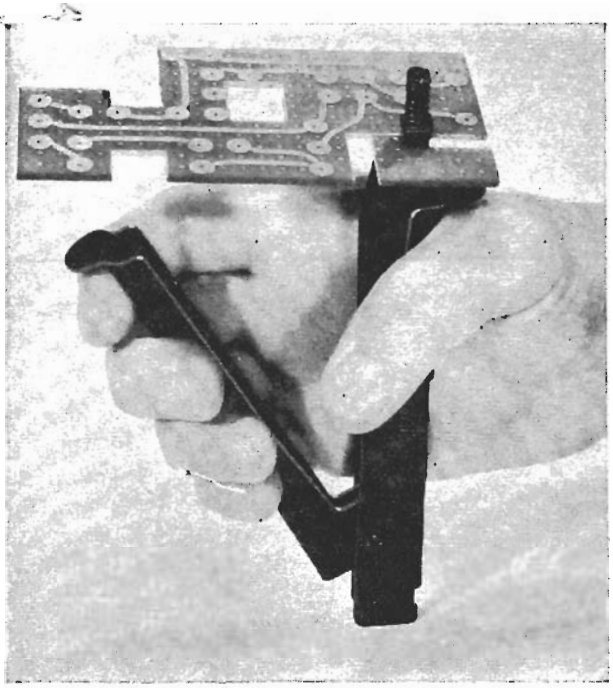

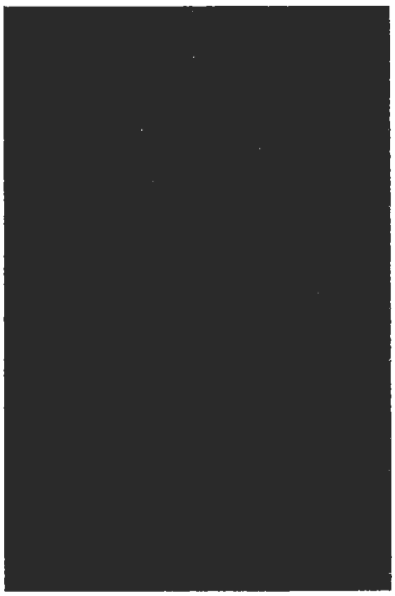

Fig. 1. A nibbling tool trims, notches, or cuts up to 18-gauge steel, 1/16" aluminum, and all types of plastic PC boards.

CUTTING, PUNCHING and DRILLING of Printed Circuit Boards

WORDS OF ADVICE FROM A PROFESSIONAL TOOLMAKER, SO YOU WON'T BOTCH THE JOB

BY ALF ADEL, W9CDB*

**Adel Tool Co., 4640 Ronald St., Chicago, Ill.*

ONE OF THE BIGGEST headaches for most electronic experimenters is the cutting and drilling of printed circuit boards, or other similar sheet plastic materials. Most PC boards are fabricated from a paper-base, thermosetting phenolic resin, making them soft and brittle, and therefore susceptible to cracking and tearing unless handled properly. However, such problems can be reduced, or even eliminated, by the use of proper tools and techniques.

The following paragraphs will tell you what tools are best to use for cutting, drilling, and punching PC boards, and which tools should NOT be used for these purposes.

Cutting. Sheet metal snips should NEVER be used to cut PC boards. Their shear angle is too great, and the use of this tool would only result in rough, ragged edges, and possible damaging or cracking of the board.

Most sheet metal power shears will cut PC boards. However, any excessive angle of the shear blade will rip the material along the cut edge. This happens because the shear blade bends the material downward at the shear point, literally

tearing the two segments apart. If you want to use power shears, the cutting angle MUST be corrected first. If this does not do the trick, try heating the PC board slightly before attempting to shear it. Do NOT try to shear thermoplastics, sueh as polystyrene, acrylics, etc., as they will *always* crack.

ground for cutting metal and usually will dig in and rip through the bottom of the hole when you're drilling through plastic. This is due to the rake angle at the cutting edge (lip) of the drill. See Fig. 2(a).

You can modify a few twist drills for drilling plastics by flattening out the rake angle. This will destroy the twist drill's

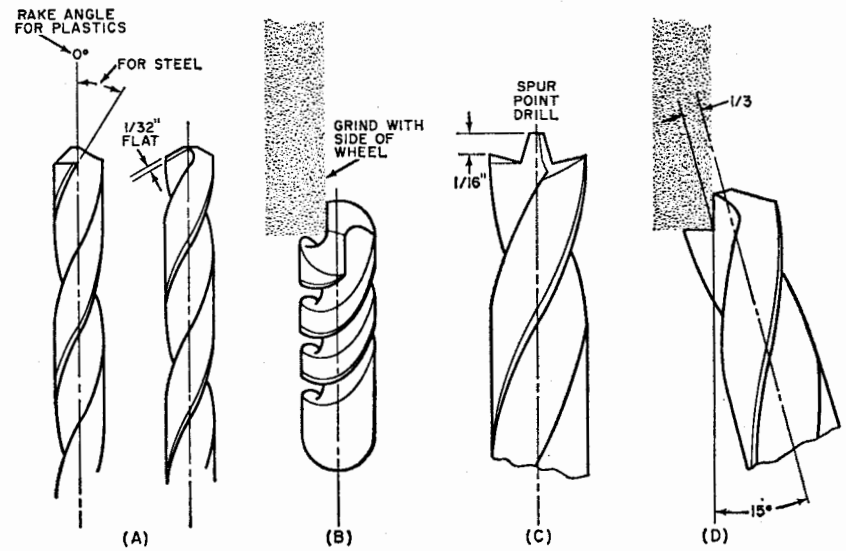

Fig. 2. Drilling neat holes in plastic is simplified if you modify some commonly used metal twist drills as shown here and explained in the text. You can reduce the rake angle of a drill to zero by grinding a $\frac{1}{32}$" flat (a) across the cutting edge on both sides as shown in (b). A spur-point drill (c) can be made from a conventional metal drill as shown in (d). These drills cannot be used on metal once they are modified.

Although a saber saw, or hacksaw, is NOT recommended for cutting a PC board, a metal-cutting bandsaw having at least 18 teeth per inch can be used. The copper foil side of the PC board should be up during the cutting operation or the foil may peel away from the base during the cutting.

Probably the best way to cut a printed board is with a nibbling tool. Nibbling is a punch-and-die method of taking small "bites" out of the plastic, thus eliminating the possibility of fracture (cracking) of the board while the punch takes the small bites. This method, shown in Fig. 1, also prevents the copper foil from peeling away from the phenolic base.

Drilling. Using a conventional twist drill to make holes in any type of plastic material (including PC boards) can be a problem. An ordinary twist drill is

usefulness for drilling metal, but the advantage gained in clean drilling through plastic will more than compensate for the investment of a few drills.

To flatten the rake angle, you'll need a high-speed grinding wheel. Clamp the twist drill so that the cutting edge can be very carefully pushed in toward the right-hand side of the grinding wheel as shown in Fig. 2(b). Grind a $\frac{1}{32}$" flat across the sharp cutting edge—in other words, reduce the rake angle from about 15 degrees to zero degrees (parallel to the long axis of the twist drill). Be sure to flatten both cutting edges.

To drill holes in PC boards larger than $\frac{3}{8}$", a spur-point twist drill is called for. These drills are not too common, but you can modify an ordinary twist drill to do the same job. Here, again, a high-speed grinding wheel is needed. In this case, the tip of the ordinary twist drill

will be cut away to create a spur-point drill as shown in Fig. 2 (c). You do this by clamping the twist drill at an angle of about 15 degrees to the grinding wheel, with the cutting edge in line with the horizontal axis of the wheel. See Fig. 2(d).

Hold the drill against the wheel and grind away the old cutting edge, except for the one-third center part, to form a spur. Do the same thing on the other side of the drill, making sure that the same amount is removed from each side of the center. The center will extend about 1/16" above the spurs, and becomes the pilot that will guide the drill. If the pilot is not exactly in the center of the drill, gently grind the high side down using the side of the grinding wheel.

To sharpen this drill, hold it exactly in the same manner used to make it originally. With the grinding wheel operating, rotate the drill clockwise about 30 degrees as you gently grind. Start each grind with the cutting edge horizontal and lift upward as you rotate. This will provide about 10 degrees of clearance at the rear of the cutting edge and the pilot.

You now have an excellent sheet-metal drill. To make it useful for plastics, grind a flat on the spurs as shown in Fig. 2(b).

Punching. Printed circuit boards can be cleanly punched by using a punch and a backup plate with matching punch/plate-hole diameters. If the hole in the backup plate is larger in diameter than the punch, many break lines, cracks, and splits will appear, as shown in Fig. 3(a). When the punch and plate hole have the same diameter, the break is clean and vertical through the material, the board will not crack, and a clean slug of material the same size as the hole will be punched out. See Fig. 3(b). This is the principle of the nibbling tool shown in Fig. 3(c).

A useful punch plate can be made as shown in Fig. 3(d). The lower plate acts as a back-up plate (die) for the material. A spacer and a couple of nuts and bolts secure the two plates together and keep them aligned. Drill various size holes through the two plates to accommodate a variety of punch sizes.

When using a punch, keep the tool at least one punch diameter away from the edge of the material.

Whenever cutting, drilling, or punching plastic materials, always use a *sharp* cutting tool to reduce friction heating—one of the main causes of cracking and tearing. -30-

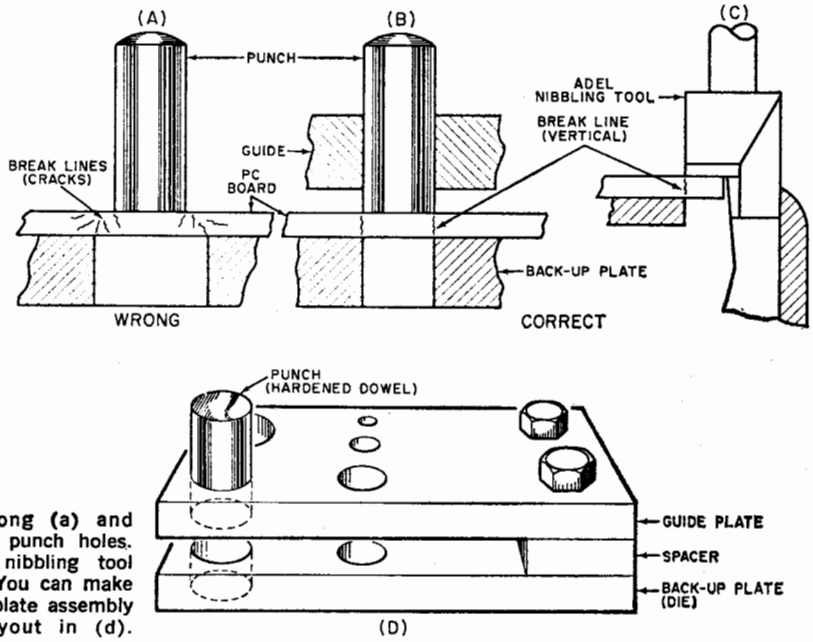

Fig. 3. The wrong (a) and right (b) way to punch holes. Operation of a nibbling tool is shown in (c). You can make your own punch plate assembly by following layout in (d).